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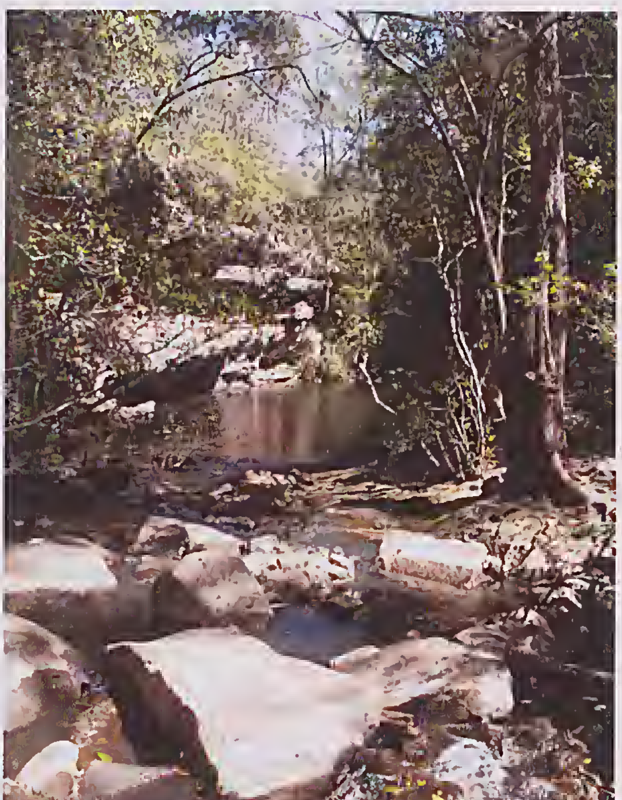

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From the Editors

One of the many attractions of studying the natural world must be its huge variety. Where else could a researcher analyse the contents of regurgitated bird pellets or observe the mating and post-mating behaviour of spiders? Examples of both types of research are presented in this issue of *The Victorian Naturalist* for the readers' delight; and much else besides.

At a time when accounts of species becoming extinct are frequent, it is pleasing to be able to report on a study of a persisting population of the threatened Brown Toadlet in rural Victoria. Similarly, we report a range extension of the White-footed Dunnart near Nowra in New South Wales.

Although disparate in specific subject matter, all the papers presented here increase our understanding of the natural world. Such knowledge is vital, of course, if we hope to conserve what we know of it, and continue to increase that knowledge through documenting those aspects of nature that are less well understood.

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Front cover: Bomaderry Creek downstream of weir (survey site 5). Riffle zone in foreground and pool in background. Habitat of Long-finned Eel, Australian Smelt, Australian Bass and Cox's Gudgeon. Photo MJ Murphy, October 2016. See page 108.
Back cover: *Correa reflexa*. Photo Jurrie Hubregtse.

The Brown Toadlet *Pseudophryne bibronii* (Anura: Myobatrachidae), at Bald Hill Reserve, Kyneton, Victoria

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Abstract
Surveys for the threatened Brown Toadlet *Pseudophryne bibronii* were undertaken at Bald Hill Reserve near Kyneton from April to June 2016. Surveys employed the Amphibian Calling Index technique, and the species was detected at five sites in the Reserve. Peak activity occurred during April and May, while no *P. bibronii* were recorded calling in June. A full chorus of *P. bibronii* was recorded at two sites, which suggests this population is of a very large size. This may be one of the largest extant Victorian populations of *P. bibronii*, making it an important site for research and conservation of this threatened species. (*The Victorian Naturalist* 134 (4), 2017, 96–100)

Keywords: Brown Toadlet, *Pseudophryne bibronii*, Bald Hill, Kyneton, Amphibian Calling Index

Introduction

The Brown Toadlet *Pseudophryne bibronii* is a terrestrial frog with a body length up to 32 mm (Fig. 1). It can be identified by its brown or grey dorsal surface, with or without black spots or squiggles. While coloured tubercles tipped with brown or orange can be present, the ventral surface has a striking, black or grey and white marbled pattern. There is an orange or yellow patch on the upper foreleg, back of thighs on the hindlegs and sometimes groin and front of thighs on the hindlegs (Anstis 2013).

Pseudophryne bibronii can be found in dry forest, woodland, shrubland and grassland. Adults take refuge under leaf litter and debris. Calling is initiated after heavy rain between Feburary and April. Eggs are laid in moist sites under rocks, logs, leaf litter, amongst vegetation and in burrows in damp soil. The eggs hatch when they are inundated or washed into adjacent ponds, and the tadpoles then undergo normal aquatic development. Metamorphosis takes three to seven months (Hero *et al.* 2004; Anstis 2013).

Pseudophryne bibronii is the most widespread of its genus and occurs along the east coast of Australia from southern Queensland to Victoria and South Australia (Hero *et al.* 2004; Anstis 2013). In Victoria, *P. bibronii* is listed as Threatened under the *Flora and Fauna Guarantee Act 1988*. The Victorian Government classifies the species as Endangered under the Advisory List of Threatened Fauna. The species was listed as Near Threatened by the IUCN in 2004 with a significant population decline, believed to be due to widespread habitat loss (Hero *et al.* 2004).

The species was once widely distributed across central Victoria (Fig. 2a); however, the majority of these records date back over 40 years from the present. There are very few records from the last decade (Fig. 2b). According to Howard *et al.* (2010), the species' elusive behaviour is likely to contribute to the lack of records.

In September 2015, a pair of *P. bibronii* was discovered under loose corrugated iron at Bald Hill Reserve, near Kyneton in central Victoria. Future surveys for the species were subsequently planned for the following autumn when *P. bibronii* would initiate breeding (Howard *et al.* 2010). This research aimed to document the extent of the *P. bibronii* distribution and abundance in the Bald Hill Reserve using an acoustic survey method.

Methods

Study Area

Bald Hill Reserve (Fig. 3) is located just east of the central Victorian township of Kyneton (-37.240296, 144.499338). The land is owned and managed for conservation by Macedon Ranges Shire Council. Bald Hill Reserve is approximately 100 hectares in size, has two farm dams and a seasonal creek that can inundate the lower sections of the reserve during heavy rainfall (Fig. 4). Ecological Vegetation Classes in the reserve consist of Grassy Woodland, Granitic Grassy Woodland, Valley Grassy Forest and a modified grassland. There is extensive

Fig. 1. Brown Toadlet *Pseudophryne bibronii* from Bald Hill Reserve.

Fig. 2 (a). All Victorian Biodiversity Atlas records (November 2016) showing the known Victorian distribution of *Pseudophyrne bibronii*; **(b)** the last 10 years of Victorian Biodiversity Atlas records of *Pseudophyrne bibronii*. The star indicates the position of Bald Hill Reserve.

historical evidence of damaging land use activities in the Bald Hill Reserve including stock grazing, recreational horse activity, quarrying and logging. The site was also used as a rifle range by the Australian Defence Force before Council ownership commenced in the 1980s (Atlas Ecology 2010).

Frog Surveys

Surveys were conducted on three separate evenings immediately after rain. Transects were identified and slowly walked to ensure adequate coverage of the reserve. The emphasis was on surveying areas most likely to contain *P. bibronii*, based on the availability of standing water. Areas of particular interest included drainage lines and old farm dams. Areas were surveyed using a standard, replicated approach. First, surveyors would listen in silence for five minutes. Subsequently, if no calls of *P. bibronii* could be heard, calls (Hoskin *et al.* 2015) were broadcast from a digital device in an attempt to trigger calling. All frog species encountered during surveys were recorded, along with air temperature and daily rainfall. Frogs were not

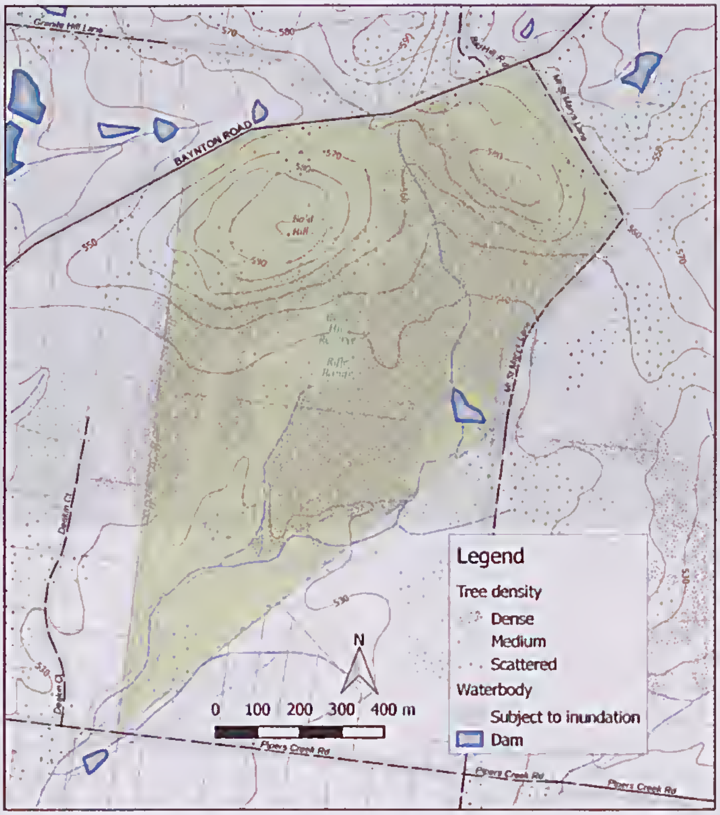

Fig. 3. Map of Bald Hill Reserve.

captured but photographs were taken to confirm correct identification (Fig. 5).

The surveys were undertaken on April 29, May 9 and June 30 in 2016. All surveys were undertaken at dusk (6 pm) and continued for a few hours thereafter.

On several occasions, *P. bibronii* were heard calling from burrows, so visuals were often not a true indication of actual numbers. It was not possible to record each calling male as at times there was a chorus of *P. bibronii* calling from burrows or beneath debris. Instead, an estimate of calling activity was recorded using the Amphibian Calling Index (ACI) (Weir and Mossman 2005; Table 1). During each survey, an index was agreed on by all participants undertaking the survey.

An obvious weakness of the ACI method was that the intensity of calling would vary with the duration of individuals calling. However, *P. bibronii* has a very short call (<0.5 sec) and therefore constant and continuous calling would be a genuine indication of a large population.

The number of survey participants varied from two to six people; however, the same project coordinator remained throughout the surveys to ensure methodological consistency. The sites chosen were far enough apart to preclude neighbouring frog communities being heard. Each site also had access to separate water bodies such as farm dams and wet ephemeral pools.

To avoid accidental introduction of pathogens, such as the Chytrid fungus, to frog populations, hygiene protocols were implemented as per recommendations by Murray *et al.* (2011). Immediately prior to surveys, all footwear was washed down with a solution of 1% sodium hypochlorite mixture.

Fig. 4. Inundated grassland habitat at site 2, lower section of Bald Hill Reserve, in September 2016.

Fig. 5. Male *Pseudophryne bibronii* calling from burrow entrance at Site 2 in April 2016. Photo M Clancy.

Table. 1. Amphibian Calling Index (Weir and Mossman 2005)

Index	Description
0	No individuals can be heard
1	Individuals can be counted, there is space between calls
2	Calls of frogs are distinguishable, but some calls overlap
3	Full chorus, calls are constant, continuous, and overlapping

Results

Pseudophryne bibronii was present at five sites on the transect. Site 1 was not included in the April survey, but apart from this, the species was recorded at all sites in the April and May surveys. *P. bibronii* was not detected during the June survey. Peak activity occurred at Site 2 in April and Site 4 in May, with ACI scores reaching 3 at these times, but otherwise indexes varied between 1 and 2. This is indicative of a significantly large population of *P. bibronii.*

Temperature on survey days ranged from 6 to 15°C; rainfall from 2 to 12 mm. Other frog species recorded close to *P. bibronii* breeding sites were the Eastern Banjo Frog *Limnodynastes dumerilii*, Common Spadefoot Toad *Neobatrachus sudelli*, Southern Brown Tree Frog *Litoria ewingii*, Plains Froglet *Crinia parinsignifera* and Common Froglet *C. signifera.*

Discussion

This study detected a significantly large breeding population of *P. bibronii* in central Victoria. The Victorian Biodiversity Atlas (November 2016) shows that there are very few records in Victoria where large numbers of *P. bibronii* have been recorded in a specific area. The Bald Hill Reserve should be considered high-quality breeding habitat for *P. bibronii* and could represent an important site for research on this threatened species.

Despite the limitations of the Amphibian Calling Index to measure population abundance, its advantages were obvious in this study. The typically cryptic calling sites of male *P. bibronii* make visual survey methods difficult; using the ACI also avoids trampling damage to the site and disruption of breeding activity. Given the variability of calling activity, it is clear that repeated acoustic surveys of an area, as practised in this study, increased the probability of detection of frog presence. This also may be achieved by installation of automated recording stations (A Hamer pers. comm.).

Taking into consideration the conservation status of *P. bibronii*, its disappearance from much of its former range, and the results of recent surveys which encountered very few individuals (Howard *et al.* 2010), the discovery reported here is both surprising and encouraging. That this population is apparently thriving in a modified and somewhat degraded habitat suggests that the kind of focused and repeated survey methodology that was employed here may possibly reveal the existence of other local populations in parts of the species' original range.

Acknowledgements

The work was funded by Macedon Ranges Shire Council. I thank Matt Clancy for assisting with the initial survey and his helpful advice. Thanks also to the Friends of Bald Hill Reserve for participating in the surveys, and Andrew Hamer for providing feedback on the manuscript. I would also like to thank the two anonymous reviewers whose comments and feedback were critical in ensuring the paper was ready for publication. The study was conducted under a Victorian State Government Scientific Research Permit (10007891) and Animal Ethics Approval (02.16).

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Contents of some Powerful Owl pellets from the Melbourne region

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Abstract
The diet of the Powerful Owl *Ninox strenua* is relatively well studied, particularly in the Melbourne area. Nevertheless, the opportunity was taken to collect 111 pellets, or partial pellets, regurgitated from birds at six sites across the Greater Melbourne area between April 2009 and February 2015. As expected from previous and more detailed studies, analysis of these pellets showed that Common Ringtail Possum *Pseudocheirus peregrinus* was the most common prey, and occurred in 79 pellets. Two unexpected findings were Swamp Wallaby *Wallabia bicolor* remains found in one pellet collected on Bourkes Creek, near the township of Emerald, and Little Red Flying-fox *Pteropus scapulatus* remains in three owl pellets collected at a site on the lower Yarra River. (*The Victorian Naturalist* 134 (4), 2017, 101–103)

Keywords: Powerful Owl, Melbourne, pellet analysis, diet

Introduction
The Powerful Owl *Ninox strenua* is the largest species of owl occurring in Australia. While the species has adapted to urbanisation in some cities—where there are unnaturally high populations of its preferred arboreal mammal prey, such as possums (e.g. McNabb 1996; Cooke 2000)—the Powerful Owl is considered to be Vulnerable in Victoria (DSE 2013) and is listed as Threatened under that state's *Flora and Fauna Guarantee Act 1988* (DELWP 2017).

Urban landscapes provide abundant prey, and large introduced trees, such as Monterey Pine *Pinus radiata*, deciduous willows *Salix* spp. and English Elm *Ulmus procera* are frequently used as roost-trees (e.g. Cooke *et al.* 2002; McNabb and McNabb 2011). Owls in urban areas also may be habituated to higher levels of disturbance than conspecifics in more natural areas (Cooke 2000). In urban areas, Powerful Owls may be restricted to areas of dense vegetation for roost sites. Moreover, breeding opportunities are limited by the reduced availability of old-growth trees with suitably sized hollows (e.g. McNabb and Greenwood 2011).

Methods
Opportunistic collections of 50 regurgitated pellets or partial pellets from Powerful Owls were made at five Melbourne Water work sites between April 2009 and February 2015 (Table 1). An additional 61 regurgitated pellets were collected by JG from a roost site near Hastings on the Mornington Peninsula, 58 km southeast of the Melbourne city centre, during November 2012 (n=27) and October 2013 (n=34). Many pellets were fragmented but all were collected below trees where Powerful Owls were observed roosting.

All pellets and pellet fragments were analysed by HB. The length and diameter of 69 intact pellets were measured to the nearest millimetre. Pellets were softened in water then broken up to separate bones from hair. Bones were identified by comparison with reference material, and hairs were identified using the methods of Brunner and Coman (1974) and Brunner and Triggs (2002). Further confirmation was provided by Barbara Triggs (see Brunner and Triggs 2002; Triggs 2004).

The frequency of each prey taxon was calculated as the percentage of pellets in which they occurred.

Results
Pellets measured, on average, 48.4 (±18.12) mm in length (n=69, range 16–110 mm) and 24.6 (±3.82) mm in diameter (n=69, range 15–33 mm).
The two most common prey species found in pellets were Common Ringtail Possum *Pseudocheirus peregrinus*, which occurred in 79 of 111 pellets, and Common Brushtail *Trichosurus vulpecula*, which occurred in 35 of 111 pellets

(Table 2). There were, however, some unexpected findings. An entire forepaw of a Swamp Wallaby *Wallabia bicolor* was found in one pellet (Table 2) collected on Bourkes Creek, near the township of Emerald, approximately 50 km south-east of Melbourne. Little Red Flying-fox *Pteropus scapulatus*, an uncommon visitor to southern Victoria (Menkhorst 1995), was found in three owl pellets (Table 2) collected at a site on the lower Yarra River.

Discussion

The diet of the Powerful Owl is well studied (e.g. Higgins 1999), particularly around Melbourne (McNabb 1996; Menkhorst *et al.* 2005; Cooke *et al.* 2006; Fitzsimons and Rose 2010), yet we have found no reports of Swamp Wallaby as prey in Victoria. The Swamp Wallaby remains were found in an isolated pellet collected at one site. This unusual observation is of interest as Powerful Owls generally feed on arboreal mammals and are believed to take most of their prey in trees (e.g. Kavanagh 2002). However, comparable macropods have been recorded previously as Powerful Owl prey in other areas. For example, Schulz (1997) found three lower jaw bones of Herbert's Rock-wallaby *Petrogale herberti* in Powerful Owl pellets and observed a female Powerful Owl clutching a sub-adult rock-wallaby at a roost in Moonlight State Forest, near Rockhampton, Queensland. Further, Kavanagh (2002) reported juvenile Red-necked Wallaby *Macropus rufogriseus* in a pellet from New South Wales, although he recognised that some of his 'unusual records may represent errors in pellet sample identification' (he gave no reason why). So we have no reason to believe Powerful Owls would not occasionally prey upon small Swamp Wallabies. Another example occurred in New South Wales where Powerful Owls were reported to feed on road-killed carrion (Braithwaite 1996), so it is possible our remains may have been from carrion even though Powerful Owls most often are believed to take arboreal prey (Kavanagh 2002).

Flying-foxes *Pteropus* spp. have been recorded as important prey of the owl in some areas, especially urban areas of Brisbane and Sydney (Pavey *et al.* 1994; Higgins 1999). So, although previous studies near Melbourne have seldom reported flying-fox as prey (e.g. Cooke *et al.* 2006), it is not surprising that Powerful Owls should prey upon flying-foxes in Melbourne (Menkhorst *et al.* 2005), where the Grey-headed Flying-fox *Pteropus poliocephalus* is now established and has a growing population.

Table 1. Sites around Melbourne where 111 Powerful Owl pellets were collected, April 2009 to February 2015.

Site	Location	Position
A	Wilsons Reserve, lower Yarra River	37.7802° S, 145.0459° E
B	Bourkes Creek, Emerald	37.9501° S, 145.4703° E
C	Brimbank Park. Maribyrnong River	37.7308°S, 144.8427° E
D	Stammer's property, Lang Lang River	38.2450° S, 145.7474° E
E	Near Hastings, Mornington Peninsula	38.3107°S, 145.1692°E.
F	Doongala Reserve, Kilsyth	37.8446° S, 145.3320° E

Table 2. Summary of prey items found in 111 Powerful Owl pellets collected at sites around Melbourne, April 2009 to February 2015. (see Table 1 for site details)

Site	Prey Species	Frequency in pellets
ACDEF	Common Ringtail Possum *Pseudocheirus peregrinus*	79 (71.2%)
DEF	Common Brushtail Possum *Trichosurus vulpecula*	35 (31.6%)
B	Swamp Wallaby *Wallabia bicolor*	1 (0.9%)
A	Little Red Flying-fox *Pteropus scapulatus*	3 (2.7%)
A	unidentified Flying-fox *Pteropus* spp.	1 (0.9%)
DE	Black Rat *Rattus rattus*	2 (1.8%)
A	Australian Magpie *Cracticus tibicen*	7 (6.3%)
ACE	Feathers, unidentifiable species	11 (9.9%)
AC	Insects (may include post-deposition additions)	10 (9.0%)
C	Plant material	1 (0.9%)
D	Snail shell	1 (0.9%)

It is interesting that although Grey-headed Flying-foxes were common in the Menkhorst *et al* (2005) study area, only one individual was found among 73 pellet samples. This is contrary to prey capture rates near other flying-fox camps (e.g. Pavey *et al.* 1994). The Little Red Flying-fox (mean 450 g) is somewhat smaller than the Grey-headed Flying-fox (mean 700 g; Menkhorst and Knight 2001) and has been reported flying within flocks of the larger species. The Powerful Owl's main prey comprises relatively larger species, such as Ringtail and Brushtail Possum rather than the Little Red Flying-fox, and it is therefore unlikely that the latter species is preferred or targeted. One explanation may be that the smaller species cannot fly as fast as its sympatric, larger cousin and may therefore have been taken in flight by an owl chasing a flock.

Although we have collected only a small number of Powerful Owl regurgitation pellets in an *ad hoc* and opportunistic manner, our findings suggest that future studies may reveal a continuously expanding range of prey of this opportunistic predator. All pellets were collected between September and April (spring to autumn) when the owls may have been supporting young. Our small sample size, collected over many months at a number of sites, prevents discussion of seasonal or spatial patterns in the diet of the Powerful Owl. However, we hope that the data we present here might contribute to future comprehensive analyses of the diet of this species in urban areas to determine the full range of prey taken and how these might vary with the duration and/or intensity of urbanisation.

Acknowledgements

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Notes on a record of the White-footed Dunnart *Sminthopsis leucopus* (Gray, 1842) (Dasyuromorphia: Dasyuridae) north of Nowra, New South Wales

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Abstract

This article describes a record of the White-footed Dunnart *Sminthopsis leucopus* (Gray, 1842) north of the Shoalhaven River near Nowra in New South Wales in 1995. Two decades later this remains the most northerly record of *S. leucopus* in New South Wales. The Nowra site was in dry open forest with very sparse understorey and ground cover, unlike the wetter, more heavily vegetated habitats where the species is typically found in Victoria. (*The Victorian Naturalist* 134 (4), 2017, 104–107)

Keywords: White-footed Dunnart, *Sminthopsis leucopus*, distribution, habitat, New South Wales

Introduction

The White-footed Dunnart *Sminthopsis leucopus* (Gray, 1842) is a small insectivorous dasyurid marsupial with a sparse and patchy distribution in Tasmania and coastal and near-coastal Victoria and south-eastern New South Wales (NSW), as well as an outlier population in a high elevation climatic refuge in the Wet Tropics of north Queensland (Woinarski *et al.* 2014). Two subspecies have been described: *S. leucopus leucopus* in Tasmania and *S. leucopus ferruginifrons* in the south-east of the mainland (Victoria and NSW), with the north Queensland population also considered likely to warrant recognition as a distinct subspecies (Blacket *et al.* 2006). Woinarski *et al.* (2014) assessed the conservation status of the Tasmanian population as Least Concern, the south-east mainland population as Near Threatened and the north Queensland population as Data Deficient, and the status of the species overall as Least Concern. The listing of the species on the IUCN Red List has been downgraded from Vulnerable to Least Concern (IUCN 2016). *Sminthopsis leucopus* is currently listed as Vulnerable in NSW under the *Threatened Species Conservation Act 1995*, Threatened in Victoria (*Flora and Fauna Guarantee Act 1988*), and Vulnerable in Queensland (*Nature Conservation Act 1992*), but is not listed in Tasmania (*Threatened Species Protection Act 1995*; current to April 2017).

The northern known limit of *Sminthopsis leucopus* in the south-east mainland was the Jervis Bay area south of Nowra (King 1980; Atlas of NSW Wildlife) until a 1995 record north-west of Nowra by the author, which extended the known distribution north by about 20 km to the north side of the Shoalhaven River. Twenty-two years later (2017) this remains the most northerly record of the south-east mainland subspecies. This paper documents information on this significant record.

Details of record

A single adult *Sminthopsis leucopus* was trapped at a site (34° 50.96' S, 150° 29.39' E) in open forest about 8 km north-west of Nowra, during a small mammal trapping session of 100 trap-nights (25 traps set for four consecutive nights) in March 1995. The traps used were standard-sized (33 × 10 × 9 cm) Elliott box-traps (Elliott Scientific Equipment, Upwey, Victoria) baited with a mixture of peanut butter and rolled oats and set at ground level. The animal was lodged as a whole spirit specimen in the Australian Museum (specimen registration number M.32088). Five Brown Antechinus *Antechinus stuartii* captures were also made at the site during the same trapping session.

The site is located about 2 km north of the Shoalhaven River and about 24 km inland from the coast at an elevation of 145 m (Australian Height Datum) and was situated on the mid-slope with a SSW aspect. The underlying geology is Nowra Sandstone. Vegetation at the site (Fig. 1) comprised open forest dominated by Spotted Gum *Corymbia maculata*, an unidentified Stringybark *Eucalyptus* sp. and Red Bloodwood *C. gummifera* with some Turpentine *Syn-*

Fig. 1. White-footed Dunnart site north-west of Nowra.

carpia glomulifera in the lower tree storey. The understorey was very sparse and comprised scattered Narrow-leafed Geebung *Persoonia linearis*, Burrawang *Macrozamia communis*, Willow-leaved Hakea *Hakea salicifolia* and Hairpin Banksia *Banksia spinulosa*. Approximately 90% of the ground cover was dry leaf litter with scattered Lomandra *Lomandra longifolia*, dry grasses, a small amount of coarse woody debris and outcropping rock. The site was situated about 25 m from a grazing paddock to the west.

The Nowra area has a mean monthly maximum temperature of 27.5° C (January), a mean monthly minimum of 6.6° C (July), and a mean annual rainfall of about 914 mm, with mean monthly rainfall ranging from 43 mm (September) to 142 mm (February) (Weatherzone 2016).

Discussion

The capture of a *Sminthopsis leucopus* with relatively minimal trapping effort as described here was fortuitous. Dunnarts are notoriously trap-shy and can often be difficult to capture using Elliott-type box-traps (Kutt *et al.* 2005; Monamy and Fox 2005; Read *et al.* 2015). They are more readily caught in pit-fall traps (Bennett *et al.* 1989; Clemann *et al.* 2005; Letnic and Dickman 2005; Ellis 2013) or with artificial shelter objects (Homan 2006, 2012; Murphy 2016).

At present, the 1995 Nowra record remains the northern known limit of *Sminthopsis leucopus* in NSW (Atlas of NSW Wildlife; Atlas of Living Australia). A gap of about 1800 km exists between the Nowra record and the southernmost record of the north Queensland Wet Tropics population at Paluma, north of Townsville (Van Dyck 1985; Atlas of Living Australia). Van Dyck (1985) predicted that records of *S. leucopus* could yet be found from southern NSW to the NSW/Qld border and into montane northern Queensland, but that this would depend on a cautious approach to identification of dunnarts in the hand. Despite considerable field survey effort for small mammal fauna in the forests of eastern NSW since 1985, including surveys for Forestry Environmental Impact Statements and the Comprehensive Regional Assessment surveys for the Forest Agreements, no other records of *S. leucopus* north of Nowra have been reported. It may be that the modern distribution of *S. leucopus* in NSW is limited to south of the Nowra area; however, Van Dyck's (1985) prediction remains valid and field researchers need to be alert to this possibility when identifying dunnarts. Lodging of voucher specimens in public museum collections is important for supporting significant records (Murphy 2005).

The Atlas of Living Australia database included a record of *Sminthopsis leucopus* from Gosford, 175 km north of Nowra on the NSW Central Coast, based on a specimen collected in 1963 and lodged in the Museum of Vertebrate Zoology at the University of California, Berkeley, USA (Catalogue no. 133341). Investigation of this record by the author and resulting re-examination of the specimen by museum staff identified it as a Common Dunnart *Sminthopsis murina* (C Conroy, Museum of Vertebrate Zoology, University of California pers. comm. October 2016). The capacity to reassess this record 53 years after it was made demonstrates the significant value of specimen-based records.

Sminthopsis leucopus occupies a broad range of habitats across its distribution: coastal heath, sclerophyll forest and subalpine rainforest in Tasmania (Green 1974; Woinarski *et al.* 2014);

coastal tussock grassland and sedgeland, scrub, wet heath, and open forest and woodland with a heathy understorey or mid-storey in Victoria (Morton *et al.* 1980; Wilson *et al.* 1986; Wilson and Aberton 2006); heathy woodland, open forest, coastal scrub and coastal dune grassland in southern NSW (King 1980; Lunney and Ashby 1987; Woinarski *et al.* 2014); and highland rainforest in north Queensland, (Van Dyck 1985). In Victoria, *S. leucopus* has been found to favour wetter, more heavily vegetated habitats in coastal and near-coastal areas where the understorey or midstorey provides a combined cover of more than 50%, while *Sminthopsis murina* is found in mallee and heath in the dry north and west of the state and in dry open forest with very low understorey cover in the south (Morton *et al.* 1980). In southern NSW *S. leucopus* apparently occupies more lightly vegetated sites that might be considered more typical of *S. murina* habitat in Victoria. In recently logged and burnt open eucalypt forest near Bega, it was found in areas with sparse (less than 51%) ground cover and did not persist when vegetation regrowth became too dense (Lunney and Ashby 1987; Lunney *et al.* 1989, 2009). In coastal heath at Jervis Bay, most captures were at sites with poor cover (including a site dominated by bare rock) and no captures were made at sites with good cover (King 1980). The Nowra *S. leucopus* site reported here was open forest with a very sparse understorey and ground cover.

Conclusion

The record of *Sminthopsis leucopus* from north of the Shoalhaven River in the Nowra area contributes to our understanding of the spatial distribution and habitat requirements of this threatened species. Whereas different preferences for vegetation cover help account for the allopatric distributions of *S. leucopus* and *S. murina* in Victoria, it is unclear what ecological separation exists between these two species in NSW.

Acknowledgements

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Eighty-eight Years Ago

The Fat-tailed pouched mouse
BY DAVID FLEAY

Our pouched mice are pretty, engaging little creatures, making most interesting pets, though their habits are nocturnal.

The slender-footed, fat-tailed species (*Sminthopsis crassicaudata*) is well distributed over the continent, spending the daylight hours in cosy nests beneath logs, boulders, or even heaps of cut gorze [sic] bushes. I had a pair of these tiny, soft-furred animals in captivity for four years, and another one, since liberated, occupied a self-made grass nest under a tobacco tin. In West Central Victoria, and on the Western District plains, these mice are by no means rare. The male is much larger than the female, and slightly larger than a house mouse.

The general colour of this species is ash or brown-grey, with lighter under-parts; a dark band usually extends from between the eyes to a point midway between the ears. The sharp-pointed nose, large dark eyes, prominent ears, and short, swollen tail, distinguish this animal at a glance from the troublesome *Mus musculus* of town and field. Roots are included in the bill of fare, but the dentition is a specialisation for the insectivorous diet.

On the plain country, I have dug these animals out of almost vertical burrows, with grass nests in an enlarged terminal chamber; but captive specimens have not attempted to burrow, though they constructed neat nests, under grass tussocks, in the cage. Ready-made homes, such as dry "yabbie" holes, are favoured, but in the winter season, especially after heavy rain, the small nests are found under old logs and rocks. Men on the land tell me that occasionally they plough these mice out of the ground. Though these useful insect-eaters are not extremely active, they very soon hide themselves under a clod of earth when disturbed.

My "Fat-tails" were extremely fond of caterpillars, crickets, moths and grasshoppers. Tiny scraps of fresh meat, with bread and milk and honey, formed a very suitable diet, and the little animals did enjoy their meals. Strangely enough, my fat-tailed mice were on friendly terms with "Erastus", a pigmy flying phalanger, and the curious family slept in the same nest. "Erastus" had no relatives to keep him company, and was quite happy with his small, grey friends.

From *The Victorian Naturalist* XLV, pp. 278–279, March 6, 1929

A general survey of the freshwater fish fauna of the Bomaderry Creek catchment in southern coastal New South Wales

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Abstract

A field survey of the freshwater fishes of the Bomaderry Creek catchment in 1994–1995 recorded nine native species and one introduced species. One of the species recorded, Climbing Galaxias *Galaxias brevipinnis*, is of conservation concern in New South Wales. A report of an additional four native species was obtained from secondary sources. A concrete weir on Bomaderry Creek was found to represent a discontinuity in the distribution of some fish species. Four out of the six diadromous species recorded in the field survey were found only below the weir, while the two potamodromous species recorded were both found above and below the weir. The subsequent decommissioning of this weir in 1998 may substantially increase the potential habitat available for diadromous fish species in the Bomaderry Creek catchment. (*The Victorian Naturalist* 134 (4), 2017, 108–114)

Keywords: survey, New South Wales South Coast, Sydney Basin bioregion, freshwater fish, diadromous, potamodromous, weir barrier

Introduction

The freshwater fish fauna of Australia has relatively low species diversity by global standards but is significant because of a high level of endemism (Allen *et al.* 2002; Leveque *et al.* 2008). River regulation and agricultural and urban development of catchments in south-eastern Australia have had a major impact on freshwater habitats and fish communities (Koehn and O'Connor 1990; Faragher and Harris 1994). Stream barriers such as dams and weirs can have a significantly adverse impact on freshwater fish populations, obstructing spawning and seasonal migrations and altering habitat conditions (Mallen-Cooper 1993; Morris *et al.* 2001; Gehrke *et al.* 2002; Rolls 2011). Government agencies and community groups have made a considerable effort in recent years to reverse some of the damage and to restore catchment connectivity and aquatic habitat values. Actions taken have included decommissioning of obsolete dams and weirs, construction of fishways specifically designed for Australian native fish, allocation of water for environmental river flows and restoration of riparian vegetation (Arthington and Pusey 2003; Bond and Lake 2003; Gilligan *et al.* 2003).

Bomaderry Creek, on the lower Shoalhaven River near Nowra on the south coast of New South Wales (NSW), is one of many coastal streams in south-eastern Australia modified by construction of a weir for local water resource development. This paper documents the results of a general survey of the freshwater fish fauna of the system prior to the decommissioning of this weir. Freshwater fishes are categorised in this paper as including estuarine species that often venture into freshwater, consistent with general references such as Allen (1989), McDowall (1996) and Allen *et al.* (2002).

Study area

Bomaderry Creek (34° 50.7' S, 150° 35.4' E) (Fig. 1 and see front cover) is located 125 km SSW of Sydney, in Dharawal Aboriginal Country in the Illawarra subregion of the Sydney Basin bioregion. The Bomaderry Creek catchment is about 36 km^2 in area, with an elevation range of 10–620 m (Australian Height Datum), and is a mix of farmland, forest and urban areas. The Bomaderry Creek system includes the upper tributaries Tapitallee Creek, Browns Creek and Good Dog Creek. The lowest part of the creek is estuarine (Fig. 2). In 1938, a concrete weir (Fig. 3) was constructed on Bomaderry Creek about 5.3 km above its confluence with the Shoalhaven River to provide a reliable water supply for the township of Bomaderry (NSW Office of Environment and Heritage 2016). Approximately 21 km of stream occurs above the weir.

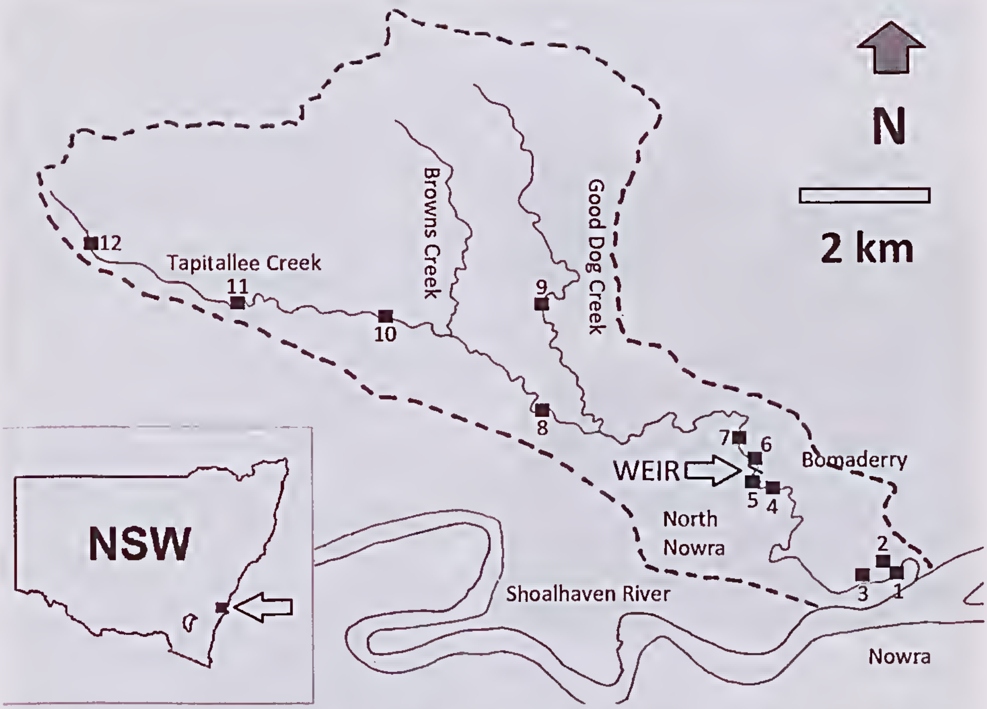

Fig. 1. Bomaderry Creek catchment on the NSW south coast. The dotted line marks the catchment boundary and the black squares mark the location of the 1994–1995 fish survey sites. The inset map shows the location of Bomaderry Creek in NSW.

Methods

The primary survey method involved wading along streams at night with a spotlight and a hand-held fine mesh dip-net. Larger fish were identified by sight while smaller species were captured for identification and then released. Species were identified by reference to Allen (1989). Surveys were done on nine nights between April 1994 and August 1995 (Appendix 1). The majority of surveying was done along the section of creek within about 1 km upstream and downstream of the weir (sites 4 to 7) (Appendix 2). This part of the creek is within the Bomaderry Creek Bushland, an urban bushland area situated between North Nowra and Bomaderry (Barratt 1994; NSW Office of Environment and Heritage 2016). Additional sites were sampled lower (sites 1 to 3) and higher (sites 8 to 12) in the catchment (Fig. 1 and Appendix 2). The author also accompanied NSW Fisheries officers surveying the lower 6 km of the creek on one afternoon and night in August 1995. The methods employed comprised electrofishing (sites 4, 5 and 7) and use of minnow traps and gill nets (sites 1, 5 and 6). Of particular interest was site 1 on the estuarine section of the creek, where the stream was too deep to sample effectively by wading. Assessment of the local status of species in the Bomaderry Creek system was based on the number of sites where species were recorded and the relative abundance of species at a site. Categories used were rare, uncommon and common.

Results

Seven species of freshwater fish (six native and one introduced) were recorded in the Bomaderry Creek catchment by the spotlight/dip-net wading survey method (Table 1). Two species (Australian Bass *Macquaria novemaculeata* and Striped Gudgeon *Gobiomorphus australis*) were found only downstream of the weir, and one species (Climbing Galaxias *Galaxias*


Fig. 2. Estuarine section of Bomaderry Creek (site 1). Habitat of Bullrout, Striped Mullet and Flat-tail Mullet. October 2016.

brevipinnis) was found only in the headwaters of the catchment (at an elevation of about 200 m AHD). One additional native freshwater species (Bullrout *Notesthes robusta*) was recorded by NSW Fisheries officers in the deeper estuarine section of Bomaderry Creek. It was captured in gill nets together with several estuarine species, of which two (Striped Mullet *Mugil cephalus* and Flat-tail Mullet *Liza argentea*) are also listed here as they can often be found in the lower freshwater reaches of coastal rivers. Overall, the field survey recorded nine freshwater fish species below the weir and five above the weir (Table 1 and Appendix 3).

Discussion

Bomaderry Creek has a relatively diverse native freshwater fish community considering its small size, and the apparent absence of additional introduced species such as Carp *Cyprinus carpio* and Goldfish *Carassius auratus* at the time of the survey is also noteworthy. The nine native species reported here comprise about 43% of the native freshwater fish species known from the Shoalhaven River downstream of Tallowa Dam (Bishop and Bell 1978; Gehrke *et al.* 2002; Murphy unpublished data) and about 29% of the species known from the south coast of NSW (Faragher and Harris 1994). Further survey effort in Bomaderry Creek, particularly in the estuarine section, would be likely to identify additional species. Barratt (2015) reported an additional four species from the lower (Bomaderry Creek Bushland and estuary) sections of the creek: Estuary Perch *Macquaria colonorum*, Freshwater Mullet *Myxus petardi*, Yellow-eyed Mullet *Aldrichetta forsteri* and Flat-headed Gudgeon *Philypnodon grandiceps*. Southern Blue-eye *Pseudomugil signifer* has been recorded in the Shoalhaven River 15 km upriver from Bomaderry Creek at the mouth of Bengalee Creek (Murphy pers. obs. Feb 1995). Other possible species include Short-headed Lamprey *Mordacia mordax*, Short-finned Eel *Anguilla australis*, Common Jollytail *Galaxias maculatus* and Empire Gudgeon *Hypseleotris compressa*.

Climbing Galaxias has been identified as a species of conservation concern in NSW (Morris *et al.* 2001), although it has not been formally listed as a threatened species under the NSW *Fisheries Management Act 1994* (current to June 2017). The distribution of this species is considered likely to have been fragmented as a result of forest clearing and predation by introduced trout (McDowall and Fulton 1996). The forest-shaded headwater stream where it was recorded in the present study is typical of the species' habitat (O'Connor and Koehn 1998). An ecologist residing in the local area has noted that Climbing Galaxias has not been seen at this site or in the local area since about 2000 and may now be locally extinct (G Daly pers. comm. October 2016).

The results of this survey suggest that the weir represented a discontinuity in the distribution of some fish species in the Bomaderry Creek system. Variation between species distributions was in part a reflection of differences in life-history habits. The two potamodromous (migrating wholly within freshwater) species recorded in the field survey, Australian Smelt *Retropinna semoni* and Cox's Gudgeon *Gobiomorphus coxii*, were evidently able to maintain populations above the weir. In contrast, only two of the six diadromous (migrating between

Fig. 3. Weir on Bomaderry Creek (site 6). Habitat of Long-finned Eel, Australian Smelt and Cox's Gudgeon. July 1993.

freshwater and the sea) species recorded were found above the weir (Table 1). A diadromous life history includes catadromous species (species that migrate from freshwater to the sea as adults to spawn, e.g. Long-finned Eel *Anguilla reinhardtii* and Australian Bass) and amphidromous species (species that live and spawn in freshwater with the hatchlings being swept downstream to the sea before returning to freshwater, e.g. Climbing Galaxias), as well as anadromous species (species that migrate from the sea to freshwater as adults to spawn—nil recorded in this study). Dams and weirs have been found to affect populations of diadromous fish species more than potamodromous species (Gehrke *et al.* 2002; Rolls 2011). Three of the four native species recorded above the Bomaderry Creek weir are known for their ability to climb vertical obstacles such as waterfalls and the damp walls of dams and weirs: the potamodromous Cox's Gudgeon (Bishop and Bell 1978; Larson and Hoese 1996) and the diadromous Long-finned Eel (Bishop and Bell 1978) and Climbing Galaxias (McDowall and Fulton 1996; O'Connor and Koehn 1998).

The Bomaderry weir was occasionally overtopped during extremely high stream flows (Murphy pers. obs.) but was usually a barrier to fish movement. The weir was obsolete by the early 1970s and in 1998 (three years after this survey) a section was removed to restore natural stream flows (NSW Office of Environment and Heritage 2016) (Fig. 4). The decommissioning of the weir has provided opportunity for additional diadromous fish species such as Bullrout, Australian Bass and Striped Gudgeon to recolonise Bomaderry Creek above the weir. The information documented here provides a useful benchmark of the composition and distribution of the freshwater fish community of Bomaderry Creek in the mid-1990s when the weir was still in place, and will be of value in any future assessment of the catchment area's freshwater fish community.

Table 1. Freshwater fishes of the Bomaderry Creek catchment 1994–1995. * Introduced species. # Estuarine species extending into freshwater.

Family	Scientific name	Common name	Local status	Life history
Anguillidae	*Anguilla reinhardtii*	Long-finned Eel	Common above and uncommon below weir	Diadromous (Catadromous)
Galaxiidae	*Galaxias brevipinnis*	Climbing Galaxias	Rare above weir (headwaters)	Diadromous (Amphidromous)
Retropinnidae	*Retropinna semoni*	Australian Smelt	Common above and below weir	Potamodromous
Poeciliidae	*Gambusia holbrooki* *	Eastern Gambusia	Uncommon above and below weir	Unspecified
Scorpaenidae	*Notesthes robusta*	Bullrout	Rare below weir (estuary)	Diadromous (Catadromous)
Percichthyidae	*Macquaria novemaculeata*	Australian Bass	Uncommon below weir	Diadromous (Catadromous)
Mugilidae	*Mugil cephalus* #	Striped Mullet	Rare below weir (estuary)	Diadromous (Catadromous)
	Liza argentea #	Flat-tail Mullet	Rare below weir (estuary)	Unspecified
Eleotridae	*Gobiomorphus coxii*	Cox's Gudgeon	Common above and below weir	Potamodromous
	Gobiomorphus australis	Striped Gudgeon	Rare below weir	Diadromous (Amphidromous)

Fig. 4. Weir on Bomaderry Creek showing where a section was removed in 1998 to restore natural stream flows. October 2016.

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Appendix 1. Survey dates for 1994–1995 Bomaderry Creek fish survey.

14 April1994	Sites 2, 3
08 September1994	Sites 5, 6
10 September1994	Sites 3, 5, 6, 7
14 September 994	Site 12
15 September1994	Sites 1, 4, 5, 6
03 June1995	Sites 8, 9, 10
11 June1995	Sites 5, 6, 7, 11
15 July 1995	Site 8
31 August1995	Sites 1, 4, 5, 6, 7

Appendix 2. Location of 1994–1995 survey sites.
Sites are numbered by increasing distance from Shoalhaven River (see Fig. 1).

1	Lions Park boat ramp, Bolong Rd, Bomaderry	34° 51.42' S, 150° 36.46'E
2	Sporting field, Bolong Rd, Bomaderry (shallowly inundated at time)	34° 51.42' S, 150° 36.37' E
3	Frog Hollow wetland, Bolong Rd Bomaderry	34° 51.55' S, 150° 36.08' E
4	Mossy Gully, Bomaderry Creek Bushland	34° 50.84' S, 150° 35.45' E
5	Pool below weir, Bomaderry Creek Bushland	34° 50.70' S, 150° 35.38' E
6	Pool above weir, Bomaderry Creek Bushland	34° 50.68' S, 150° 35.39' E
7	End of West Cambewarra Rd, Bomaderry Creek Bushland	34° 50.49' S, 150° 35.24' E
8	Hockeys Lane crossing, Tapitallee Creek	34° 50.24' S, 150° 33.69' E
9	Main Rd crossing, Good Dog Creek	34° 49.40' S, 150° 33.71' E
10	Tapitallee Rd crossing, Tapitallee Creek	34° 49.50' S, 150° 32.48' E
11	Browns Mountain Rd crossing, Tapitallee Creek	34° 49.39' S, 150° 31.34' E
12	Private property on Flannery Rd, Tapitallee Creek	34° 49.07' S, 150° 30.44' E

Appendix 3. Freshwater species recorded at each of 12 sites in Bomaderry Creek catchment 1994–1995. Sites 1–5 were below the weir and sites 6–12 above the weir.

	Site number											
Species	1	2	3	4	5	6	7	8	9	10	11	12
Long-finned Eel					x	x	x	x	x		x	
Climbing Galaxias												x
Australian Smelt				x	x	x	x	x		x		
Eastern Gambusia		x					x	x				
Bullrout	x											
Australian Bass					x							
Striped Mullet	x											
Flat-tail Mullet	x											
Cox's Gudgeon				x	x	x	x	x		x		
Striped Gudgeon			x									
Total	3	1	1	2	4	3	4	4	1	2	1	1

Ninety Years Ago

EXCURSION TO FISH HATCHERIES

About 30 members and friends attended the excursion to the Fish Hatcheries – at Studley, Park, under the leadership of Mr. F. Lewis, Chief Inspector of Fisheries and Game, on the afternoon of Saturday, September 10th. After giving a short explanation of the methods of hatching the eggs of Rainbow and Brown Trout, Mr. Lewis conducted the party through one of the hatcheries, where the eggs of these fishes were in process of being hatched. The ova were in various stages of development. The leader showed us through another hatchery, where the most modern apparatus for the propagation of fish has been installed, with the object of hatching native fishes, such as Murray Cod, Perch, and Blackfish. Success, it is confidently expected, will be ultimately achieved. The ponds in which many of the more mature fishes are kept were inspected. A vote of thanks was tendered to Mr. Lewis.—L. L. HODGSON.

From *The Victorian Naturalist* XLIV p 169, October 5, 1927

Behaviour of Daddy Long-legs spiders *Pholcus phalangioides* at Notting Hill, Victoria

Introduction

The Daddy Long-legs spider, also known as the Cellar spider or Long-bodied Cellar spider, was first recorded for science 242 years ago by Swiss entomologist Johann Kaspar Füssli, as '*Pholcus phalangioides* (Fuesslin, 1775)', and was the only spider he described (Wikipedia website). This species is believed to have been introduced to Australia (Walker *et al.* 2003) from Europe (Main 1976) and is often referred to as 'cosmopolitan' (e.g. Mascord 1980; Uhl 1998).

With its small body and long spindly legs, this spider is easy to recognise. It lives near humans, and is commonly found in dark areas inside constructions such as houses, garages and sheds (Walker *et al.* 2003). It builds an untidy web, in which it hangs upside down, and feeds mainly on insects and spiders, including its own species. It also feeds on slaters (woodlice) (Savory 1926; Child 1968). When disturbed in its web, it responds by setting up a very fast spinning motion so that its outline becomes blurred (Bristowe 1958). The lifespan can vary from three months to two years (Museum Victoria website) or about three years (University of Michigan Animal Diversity Web). The male lives for up to one year (Michalik and Uhl 2005).

Daddy Long-legs spiders go through five moults before they reach maturity (Bristowe 1958). They generally mature and mate in summer. After laying her eggs, the female surrounds them with an open mesh of spider silk, and holds them with her chelicerae (Main 1976). The open mesh is sufficient because the eggs stick slightly to one another in the form of a small sphere (Savory 1926). Spiderlings emerge after two to three weeks (Bristowe 1958) or 23 to 31 days (Uhl 1998), and the mother spider stays with them for about nine days before they disperse and fend for themselves (University of Michigan Animal Diversity Web).

Daddy Long-legs spiders at Notting Hill

Daddy Long-legs are the commonest spiders in our house, but are rarely seen doing anything apart from hanging in their webs (sometimes feeding from prey, including other Daddy Long-legs, as in Fig. 1) or moving from one location to another. Early in 2017, I had the good fortune to observe three events in the lives of these creatures, one in January/February, one in March, and the other in April.

Fig. 1. Female Daddy Long-legs spider feedingfrom another Daddy Long-legs. Photo Jurrie Hubregtse.

January/February 2017

On 11 January, I noticed a female Daddy Long-legs spider carrying her spherical bundle of eggs on our toilet wall, about 18 cm above floor level (Fig. 2). I am not sure when she laid the eggs, but the next day I saw her lumbering up the wall with them. On 13 January, she settled on the opposite wall, about 140 cm above floor level (Fig. 3), after a journey of more than four metres, during which she lost one leg—permanently, since she was fully grown and would not moult again (Pasquet and Leborgne 2011)—and her bundle of eggs lost its spherical shape (Figs 3 and 4). As far as I could tell, she remained practically motionless for the following 15 days.

On 29 January, the mother-to-be let go of the bundle of eggs temporarily (Fig. 4) and appeared to construct a maternal web for the youngsters to move into. She seemed to keep

Fig. 2. Female spider with eggs, 11 January 2017.

Fig. 3. Female spider with eggs 13 January 2017. Photo Jurrie Hubregtse.

Fig. 4. Female spider apparently constructing a maternal web.

Fig. 5. Female with hatching spiderlings. Photo Jurrie Hubregtse.

one leg in contact with the eggs as she worked. The spiderlings had hatched by 7.48 am on 31 January (Fig. 5), and on the afternoon of 1 February, some time between 1.30 pm and 4.11 pm, they moved into the maternal web (Fig. 6). There were 26. The mother was holding the empty cocoon at 4.11 pm, but had dropped it by 10.42 pm.

Along came a spider …

On 3 February, a larger Daddy Long-legs spider came to the maternal web (Fig. 7), and the female retreated down the wall (Fig. 8). Several times, it seemed that the female tried to return (as in Fig. 9), but preferred to avoid the intruder (Fig. 10). Finally, she chose to stay in a position about 17 cm below the group of spiderlings, and the intruder returned to the maternal web (Fig. 11).

On 4 February, I took the larger spider outside because our arachnophobic four-year-old granddaughter was about to arrive. The mother spider did not move from her position below the spiderlings.

On 9 February, it was clear that the spiderlings had moulted and were noticeably larger

Fig. 6. Female with spiderlings in maternal web. Photo Jurrie Hubregtse.

Fig. 7. Male spider arrives.

(Fig. 12). On 10 February, the young spiders dispersed across the wall, and by the morning of 11 February they and the mother spider had all disappeared.

March 2017: mating

On 29 March, a pair of Daddy Long-legs spiders mated in our kitchen. I do not know how long they were there: according to Bristowe (1958) mating can take up to three hours. After

Fig. 8. Female retreats down the wall, with the male in pursuit.

Fig. 9. Female appears to be trying to return to the spiderlings.

Fig. 10. Female showing no interest in the male.

Fig. 11. Male returns to the spiderlings.

Fig. 12. Newly moulted young Daddy Long-legs spider. Photo Jurrie Hubregtse.

some time the female departed, but the male stayed for several more hours before moving to a different location. The male and female spiders were similar in size.

Bristowe (1958: 111) explains how the male transfers sperm to his palps before mating takes place:

> A drop of sperm is deposited on a thread held taut across his genital opening and from here it is picked up in his chelicerae and absorbed by alternate applications of his palps ... after one or two quick jerks with his palps succeeds in inserting both simultaneously.

Figure 13 shows the male's palps, and Figure 14 shows the spiders mating.

April 2017: cannibalism

Two female spiders were observed feeding from captured Daddy Long-legs, one on 4 April (Fig. 1) and the other on 8 April. I collected the victims after their captors dropped them. On 11 April, a third dead Daddy Long-legs wrapped in spider silk, in the manner used by this species, was found on our kitchen bench. All three victims were females (pers. obs.), and judging by their small size they had not reached maturity.

Discussion

Behaviour of the January/February spiders

I was puzzled about the arrival and behaviour of the larger spider. Queensland Museum Arachnologist Robert Whyte recommended contacting Dr Bernhard Huber, an expert in *Pholcus* species, at Alexander Koenig Zoological Research Museum in Bonn, Germany.

Dr Huber replied that the larger spider was definitely a male, which seemed to be checking out the female, and the female was trying to avoid him because she was unreceptive. He did not think the male was interested in the spiderlings (B Huber pers. comm. 27/02/2017). Maybe the male stayed near the spiderlings in anticipation of the female returning to them, but it seems that after several attempts at returning and receiving unwanted attention from the male (as in Fig. 10), she gave up and stayed further down the wall, even after the male was removed.

Number of eggs laid

The female Daddy Long-legs spider at Notting Hill produced 26 eggs. The number of eggs laid by this species can vary considerably, from 15 (Savory 1926) to 60 (Penn State College of Agricultural Sciences) or more (Uhl 1998). It is interesting to note that Uhl (1991) found that the female is able to produce several batches of eggs after a single mating, even up to one year later. Bristowe (1958: 112) also mentioned that 'a female can lay fertile eggs in May or June after a mating the previous summer'.

Fig. 13. Male spider, showing palps. Photo Jurrie Hubregtse.

Fig. 14. Daddy Longlegs spiders mating. Photo Jurrie Hubregtse.

Time taken for the eggs to hatch and spiderlings to disperse

Assuming that the spider at Notting Hill had laid her eggs shortly before I saw her on 11 January, the eggs took about 21 days to hatch. This is within the time given by Bristowe (1958) and a little less than the minimum time recorded by Uhl (1998). The spiderlings dispersed nine days after they entered the maternal web, and had disappeared by the tenth day. This agrees with the time given by the University of Michigan Animal Diversity Web.

Sexual dimorphism

Most sources of information about the sizes of male and female Daddy Long-legs spiders state that the body of the female is longer than that of the male. These sources include Wikipedia web site (female 9 mm, male slightly smaller); University of Michigan Animal Diversity Web (female 8 mm, male 6 mm); Museum Victoria web site (female 20 mm, male 16 mm); Penn State College of Agricultural Sciences (female 7–8mm, male 6 mm); Mascord (1980) (female up to 9 mm; male slightly smaller, with a more

rounded body); and Whyte and Anderson (2017) (female 4 mm, male 3.5 mm).

According to Simon-Brunet (1994: 166), 'The male and female Daddy Long-legs Spider are very much the same size'. Walker *et al.* (2003) describe the sexes as similar, each with an adult body length of 8 mm. I was not able to measure any of the spiders, but those seen mating in March were similar in size.

Schäfer *et al.* (2008) state that mature Daddy Long-legs spiders vary in size, the males being slightly larger than the females. This is evident in Figs 7–11, and was confirmed by Dr Huber. Bristowe (1958: 111) noted that at times the female 'is visited by an even slimmer and longer legged male'.

Presumably, the information about the female being larger than the male has been accepted without question because in most spider species this is the case. However, as Savory (1926: 79) pointed out, the Daddy Long-legs spider 'is a species that is different almost in every way from the majority of its kind'.

Conclusion

I have noticed Daddy Long-legs spiders feeding on their own species before, but this is the first time I have been able to determine the gender of some of the captors and victims. This is the first time I have seen Daddy Long-legs spiders mating, and the first time I have found a female with eggs. I am awed by the amount of energy that must be in each egg—enough to power a spiderling through to its first moult and subsequent venture into the surrounding habitat. Observing these spiders has been a rewarding experience, but although they are so widely distributed and well known, finding reliable information about them has been a bit of a challenge.

Acknowledgements

Thank you to Robert Whyte (Queensland Museum) and Dr Bernhard Huber (Alexander Koenig Zoological Research Museum, Bonn) for their assistance. Thank you also to Jurrie Hubregtse for supplying seven of the photographs, Dr Gary Presland for obtaining some of the reference material, and Max Campbell for commenting on a draft.

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A Field Guide to Spiders of Australia

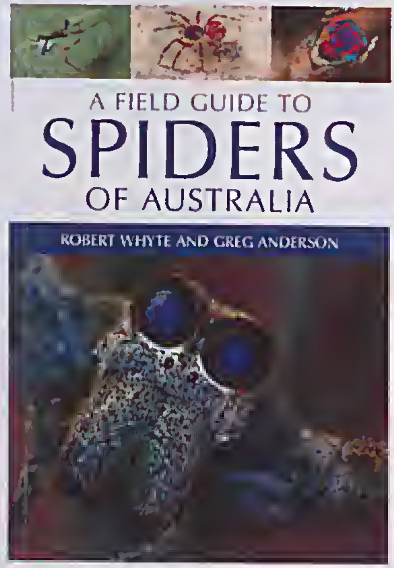
by Robert Whyte and Greg Anderson

Publisher: *CSIRO Publishing, 2017. 464 pages, paperback, colour photographs. ISBN 9780643107083. RRP $49.95.*

The preface to Robert Whyte and Greg Anderson's *A Field Guide to Spiders of Australia* tells of a more-than-10-year gestation period for this new book. Challenged by the lack of a comprehensive, non-technical, practical field guide to Australian spiders, Robert and Greg began a journey of writing a field guide that might avoid the overuse of technical terms, be illustrated with an amazing assemblage of over 1300 colour images, and act as a popular field guide to Australian spiders. I believe they have well and truly achieved their goals.

The book begins with a foreword by the well-known natural history writer Tim Low—a long-term friend of Robert. The introductory chapters include several popularly written and enjoyable chapters such as 'From arachnophobia to arachnophilia', 'Determining species—everything helps, including genitalia' or 'Parts of a spider—the need-to-know terms' as well as a fulsome background chapter titled 'Australia's rich arachnological history'. Another chapter, titled 'Shortcuts to identification', explains the importance of understanding spiders: Behaviour, Eyes, Spinnerets, Location, Webs, Burrows, Egg Sacs and Leaf-curlers. These chapters provide a solid introductory foundation to anyone not well-versed in spider terminology, taxonomy, behaviour or history, and sets the tone for this well-researched and entertainingly written book.

The introductory chapters also dispel the two great Australian spider myths—firstly, that Daddy Long-legs spiders are the most venomous spiders in the world, but because their fangs cannot penetrate human skin humans are miraculously safe; and secondly, the old chestnut that the bite of a White-tailed spider can cause necrotic wounds that do not heal, supposedly requiring limb amputation or skin grafts. This idea has been around since the early 1980s, when it began its mythological life as the 'Mystery Spider'. Both of these resilient myths have a phoenix-like ability to reappear online or in newspapers when least expected.



Although titled 'Spider families from A to Z', the authors have cleverly divided the book on the basis of common versus rare spider families in their presentation of Australian spiders. Perhaps some scientifically minded readers will dislike this split. The family treatments begin with 30 common Araneomorphae families followed by all nine known Mygalomorphae families. The remaining 39 Araneomorphae spider families described as 'Little-known spider families' then follow. I'm sure debate over family allocations into 'common' or 'rare' will 'rage' for some time. For example, the family Dysderidae contains a single species, the introduced Woodlouse hunter, *Dysdera crocata*. This is a common and easily recognisable spider found in Adelaide, Melbourne, Sydney and Tasmania but is placed in the 'little-known' family category. Conversely, the rarely seen Crevice Weavers (family Filistatidae), which are associated with tree bark, are placed in the common family sec-

tion. However, I believe anyone using this book as a practical field guide will find common versus little-known divisions most useful.

To assist with the quick location of family groups throughout the book, the fore-edge of the book is colour coded. The Australian spider fauna has been divided into 15 different common name groups—Orb-weavers, Swift spiders, Net-casting spiders, House spiders, Slender sac spiders, Ground spiders, White Tails, Prowlers, Jumpers, Redback spiders and relatives, Crab spiders, Mouse spiders, Australian Funnelwebs, Spiny Trapdoors and finally Australian Tarantulas. Each of these groups has been assigned a rectangular coloured swatch. Similar coloured swatches appear throughout the book on the pages relevant to each of the common named groups creatingan effective and easy means to find any particular common name group.

I am impressed with the nomenclature (naming) used in this book. It is often difficult to keep up with the latest valid scientific name but the authors have contacted experts around the world to ensure the most up-to-date nomenclature has been used. Some people dislike common names as they can often change between states, generally leading to utter confusion in communications. However, the authors have done their best to attach common names only where appropriate. They have even created whole groups of new common names for a wide range of spiders. For example, the species of the Salticidae jumping spider genus *Opisthoncus* have been freshly named as: 'Two-spot-big-jawed-northern', 'Long-legged jumper', 'Prowling jumper', 'The Murderer' 'Black-thighed jumper', 'Scaly-toothed jumper', 'Cyclops Jumper' and so on. Whether or not these common names become used regularly will be a matter for time to decide.

There are two indexes to this book: one is called 'Index' and is the Main Index, while a second is called 'Index of family common names'. It is difficult to understand the rules used to compose these indexes. Some of the names in the index of family common names, such as 'Comb-footed spiders', appear in both indexes, whereas other common family names such as 'Cosmopolitan spider hunters' appear only in the 'Index of family common names'. Most specific common names such as 'Green-headed ant mimic' (*Poecilipta kohouti*) do not appear in the main index, which seems contrary to the aim of writing a non-technical, practical field guide; however, spiders named to genus level only (e.g. *Gnaphosid* sp.) do appear in the main Index.

The spider imagery presented throughout this book is superb for its quality, variety and attention to detail. The over 1300 spider images, contributed by 62 photographers, are the stars of this book. Images of juveniles, intraspecific variations, undescribed and named species are all displayed. I commend to you the jumping spider section, especially the Peacock spiders (*Maratus* spp. beginning on page 258) which shows 60 images for the 49 known species in this genus. How and why is something so small so brightly and magically coloured?

The book ends with a two-page diagram showing the 'Spider—family tree'. It begins with the division of animals into the categories Bilaterally symmetrical, Radially symmetrical and Sponges. Then it branches to the Arthropods, through into millipedes and centipedes, crabs, prawns and lobsters, the six-legged insects and the Chelicerata (Arthropods with jaws, which includes the spiders). Finally, the spiders emerge alongside scorpions, harvestmen, mites and ticks as well as pseudoscorpions. From here the division is into Araneomorphae and Mygalomorphae and down into a network maze showing the interrelatedness of all spider families. It is a fascinating and strikingly simple look at the evolution of spiders in a nutshell.

Finally, I thoroughly recommend this book for personal enjoyment, as a field guide or as a way to enthuse someone new to the field of Australian spiders. I sincerely congratulate the authors on their 10-year project (i.e. headache and joy). I am sure this book will win many awards.

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